

The Weather Is Our Water Supply: **Community Involvement in Monitoring Climate**

Nolan Doesken

Colorado Climate Center
Atmospheric Science Department
Colorado State University

Presented at New Mexico State University
March 10, 2005, Las Cruces, NM.



Beginnings

- ❑ After the State Climatologist positions were abolished by the federal government in the early 1970s, many states gradually established state funded climate offices. Many were at land-grant universities.
- ❑ The Colorado Climate Center was established at Colorado State University in 1974 within the Colorado Agricultural Experiment Station.



Who Are We?

- Roger A. Pielke, Sr.

Professor, Atmospheric Science and
State Climatologist,
pielke@atmos.colostate.edu



- Nolan J. Doesken

Climatologist and Senior Research
Associate,
nolan@atmos.colostate.edu



- Odie Bliss

Coordinator, odie@atmos.colostate.edu

- Marty Osecky

System Administrator



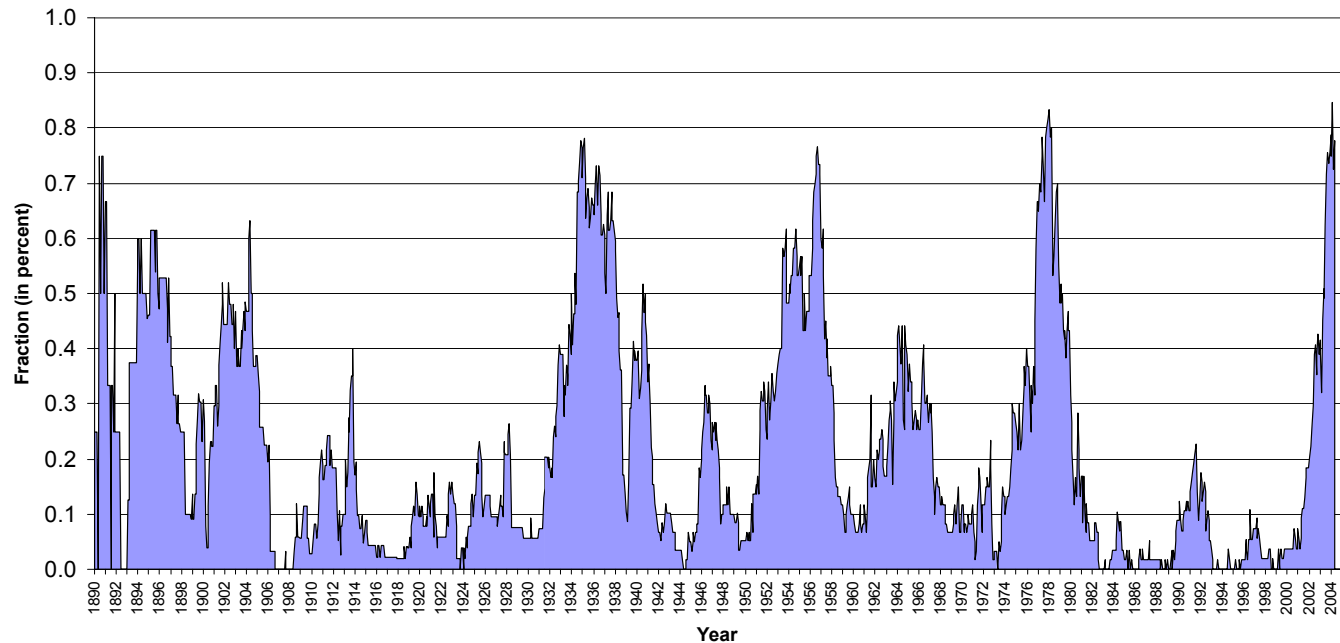
What We Do....

Climatic Research

- Instrument Comparison Studies, Drought, Snow, Variability and Trends, Impacts and Modeling, etc.

Fraction of Colorado in Drought

Based on 48 month SPI
(1890 - May 2004)



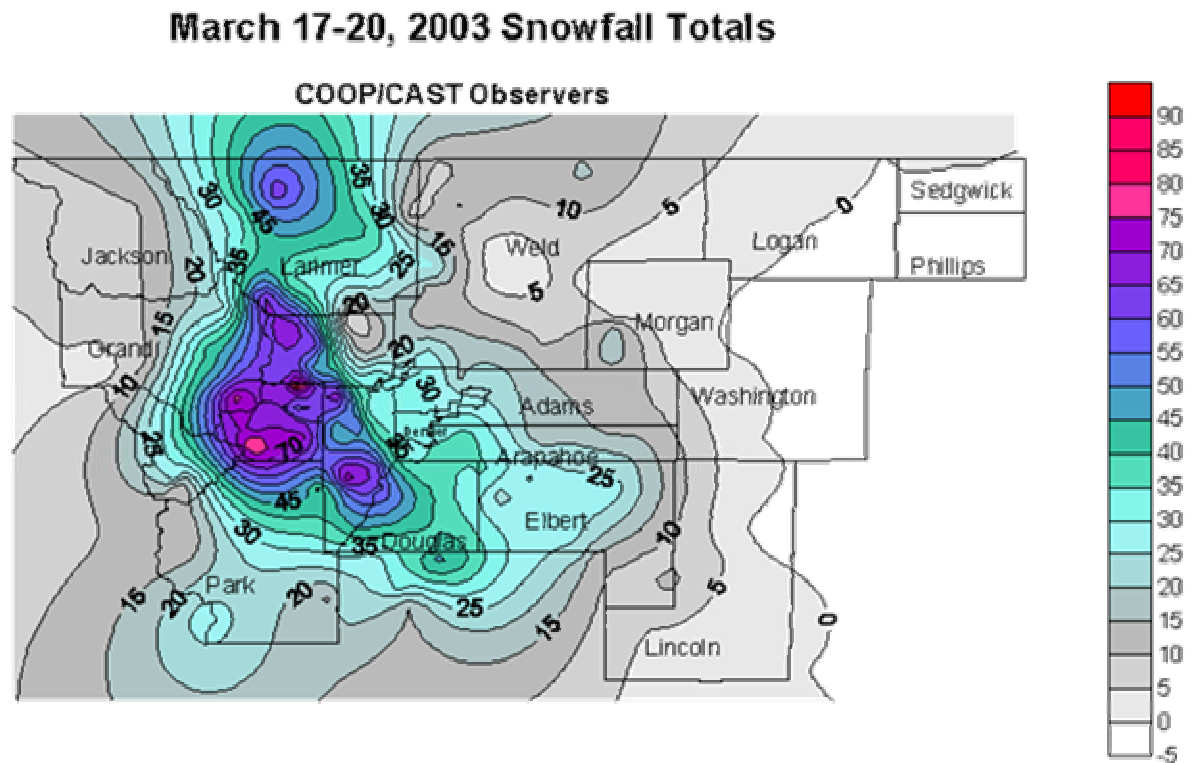
Data Acquisition and Archive

- Elements: temperature, precipitation, snow, wind, solar, evaporation, soil temperatures, humidity, cloud cover



Monitor the Climate of Colorado

- Drought, flooding, blizzards, tornadoes, temperature extremes, Heating/Cooling Degree Data, etc.





Disseminate Information

- ❑ Farmers, ranchers, consultants, engineers, water resources, utilities, construction, lawyers, federal, state and local governments, schools, universities, and many others.

- ❑ HOW? Website, phone, fax, email

<http://ccc.atmos.colostate.edu>

(970) 491-8545 phone

(970) 491-3314 fax

Colorado Climate Center

Colorado State University
Knowledge to Go Places

Quick Links: [Home](#) | [General Information](#) | [Past President's Corner](#) | [Contact Us](#) | [Staff](#) | [Policy Statement](#) | [AASC](#) | [Search](#) | [Site Map](#)

- Fort Collins Weather
- Climate of Colorado
- Data Access
- Requests for Data
- Drought Resources
- Major Weather Events
- Climate Magazine
- News Releases
- Publications
- For Fun: Q & A

- CoAgMet (Colorado Agricultural Meteorological Network)

- CoCoRaHS (Community Collaborative Rain, Hail and Snow Network)

- Private Access Area



[Subscribe here!](#)

Welcome to the Colorado Climate Center!

The Colorado Climate Center is part of the [Department of Atmospheric Science](#) at [Colorado State University](#). Our goal is to assist the state of Colorado in monitoring climate over time scales of weeks to years. We also recognize that climate involves complex interactions between the atmosphere, the oceans, continental glaciers, and the land. Vegetation processes are an important component of the climate system. This service should contribute to a reduction in the state's vulnerability to climate variability and change.

We provide links to regional climate centers and to the National Climate Data Center where detailed climate information is provided. Other valuable climate links are also listed as additional data resources.

Our publication, [Colorado Climate](#), provides articles to the public on a variety of topics. Past issues are available online as electronically accessible files.

Colorado's climate is fascinating, and we hope you learn more concerning this subject through our web site

What's New



- You need Acrobat reader to view the links below.

- Available as pdf (December 2004): ["Storming the State."](#) From the Colorado Agricultural Experiment Station 2004 Annual Report.
- Discussion forum: [A Broader Perspective on Climate Change is Needed](#) by Roger Pielke Sr. in the September issue of Global Change Newsletter, No. 59.
- Press Release, May 21, 2004: [Why so Dry?](#) article by [Science@NASA](#) featuring quotes from Roger Pielke, Sr. (audio version available on-line).
- Press Release for April 28, 2004: [Colorado State's CoCoRaHS needs Denver-Area Weather Watchers to help make](#)

Current Fort Collins Weather

57°F as of 3:30 PM on Mar 7, 2005

Relative Humidity: 15.6%
Dew Point: 10.3°F
Pressure: 24.94 inches
Wind: From the NW at 8.8 mph

[Graphs](#) | [Recent Measurements](#)

Latest Colorado Climate Center News

 Annual AASC meeting will be June 23-24, 2005, Savannah, Georgia, in conjunction with two [AMS Conferences](#).

March 2003 Winter Storm Summary & Pictures

[Click here to read the full summary](#)

[Click Here To View Digital Slide Show](#)

Drought Monitor

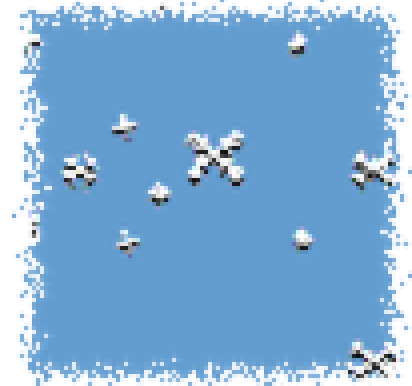
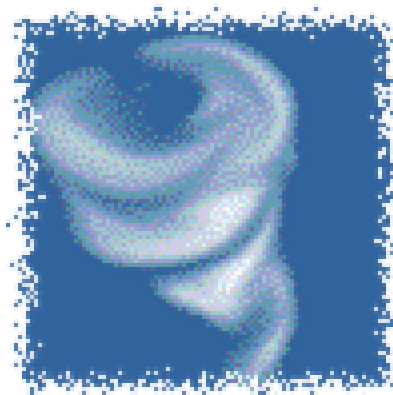
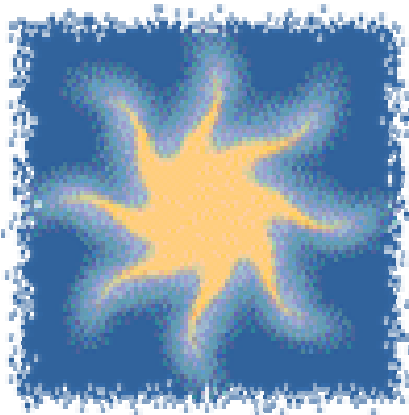
U.S. Drought Monitor

March 1, 2005

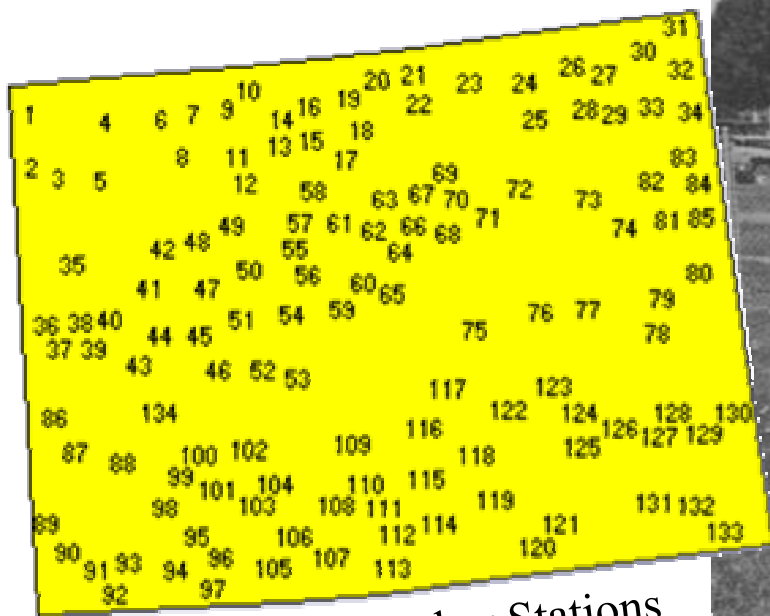


<http://ccc.atmos.colostate.edu>

How Do We Monitor Our Climate?



National Weather Service Collaboration



Cooperative Weather Stations
in Colorado



Typical Cooperative Weather Station

USDA, Natural Resources Conservation Service

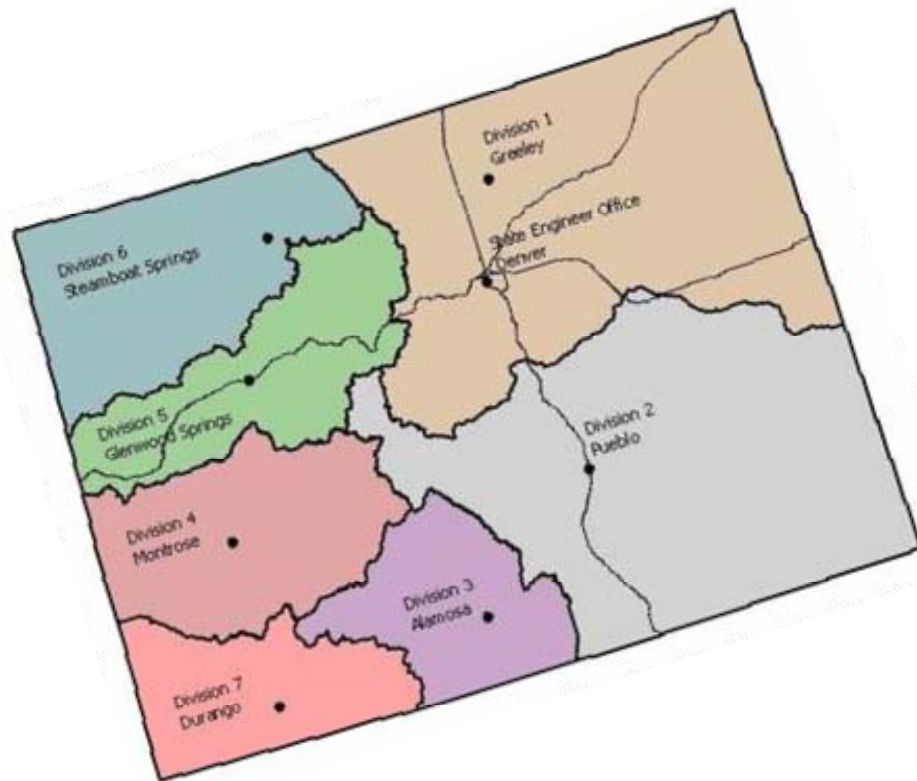


Typical NRCS Snotel Site

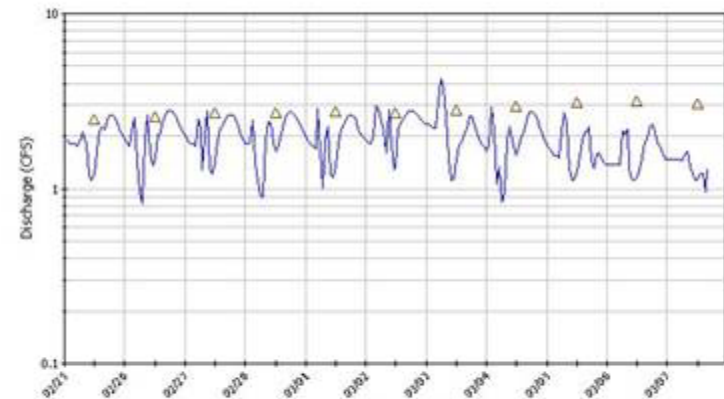


NRCS Snotel Sites for Colorado

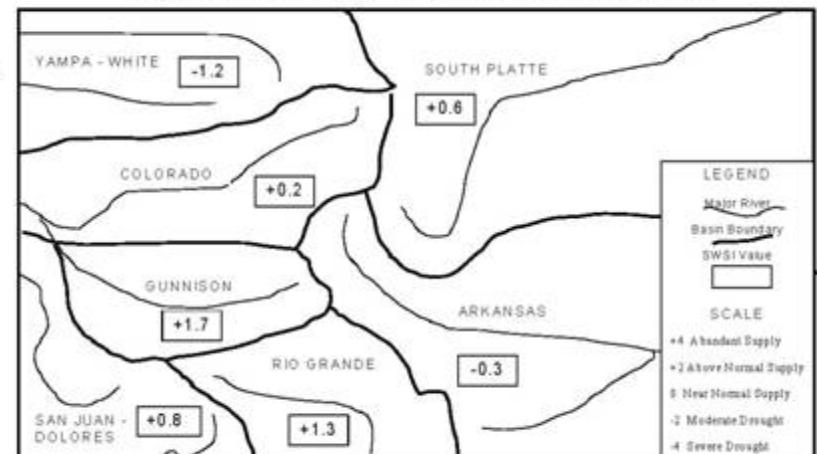
State Engineer's Office



NORDSCCO Discharge Graph (Hourly Average)

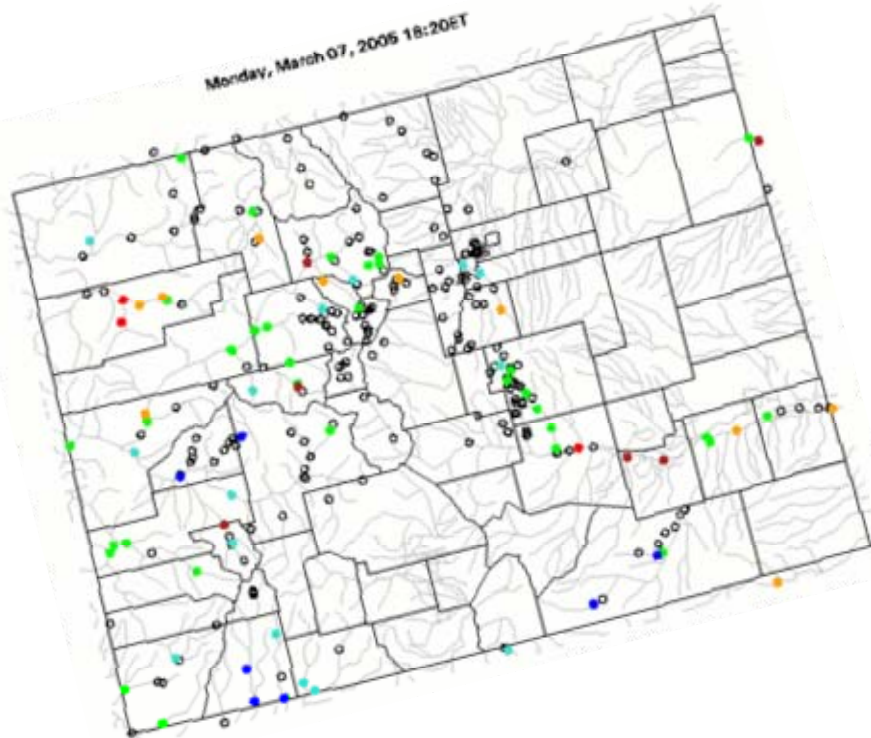


SURFACE WATER SUPPLY INDEX FOR COLORADO

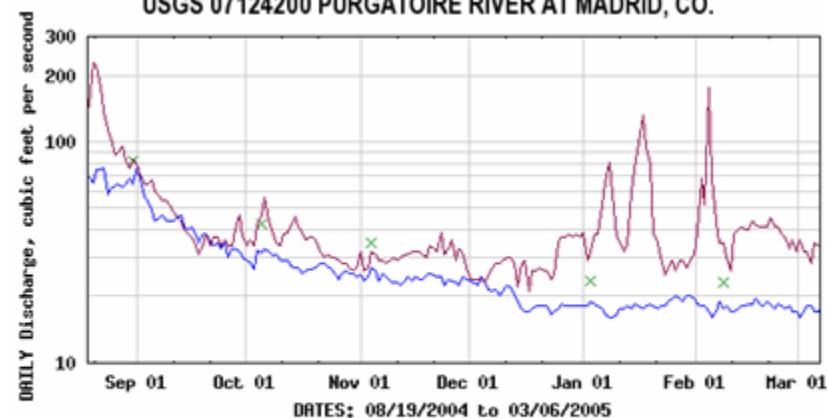


JANUARY 1, 2005

U.S. Geological Survey



USGS 07124200 PURGATOIRE RIVER AT MADRID, CO.

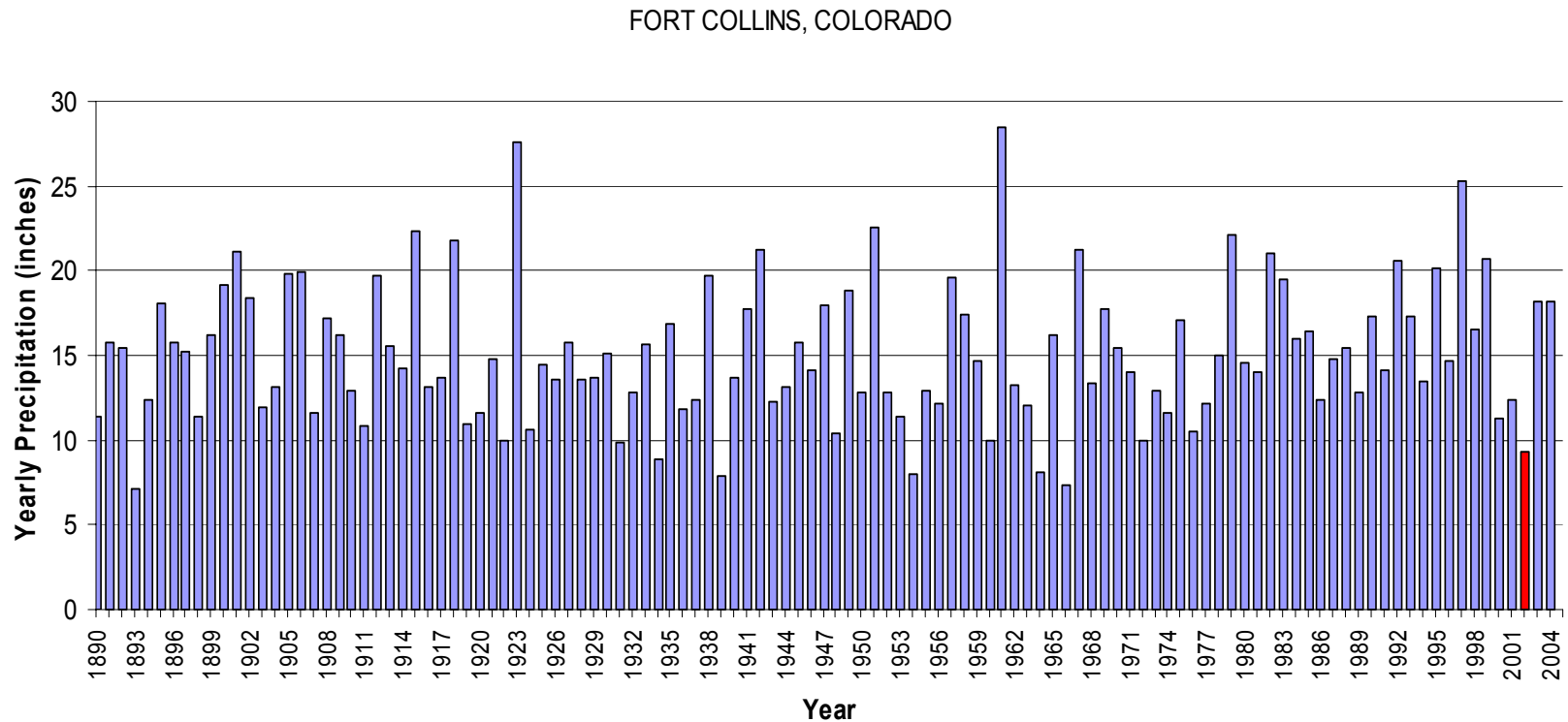


EXPLANATION

- MEDIAN DAILY STREAMFLOW BASED ON 32 YEARS OF RECORD
- × MEASURED Discharge
- DAILY MEAN DISCHARGE

Colorado Climate Center Monitoring Activities

- Fort Collins Historic Weather Station – Continuous observations from 1889 to present

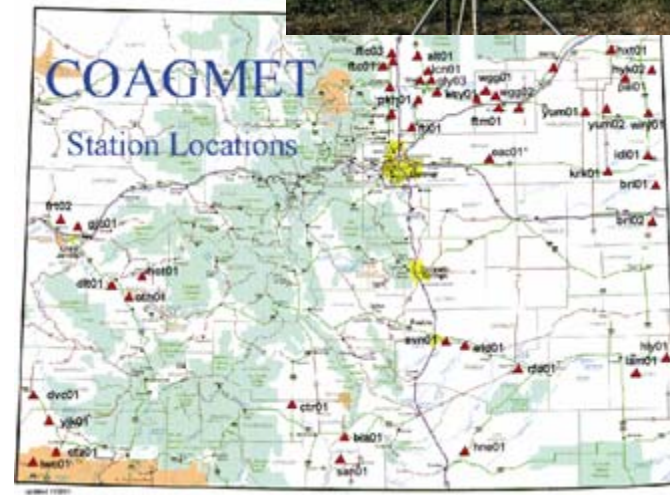


CoAgMet

Weather Data for Agriculture

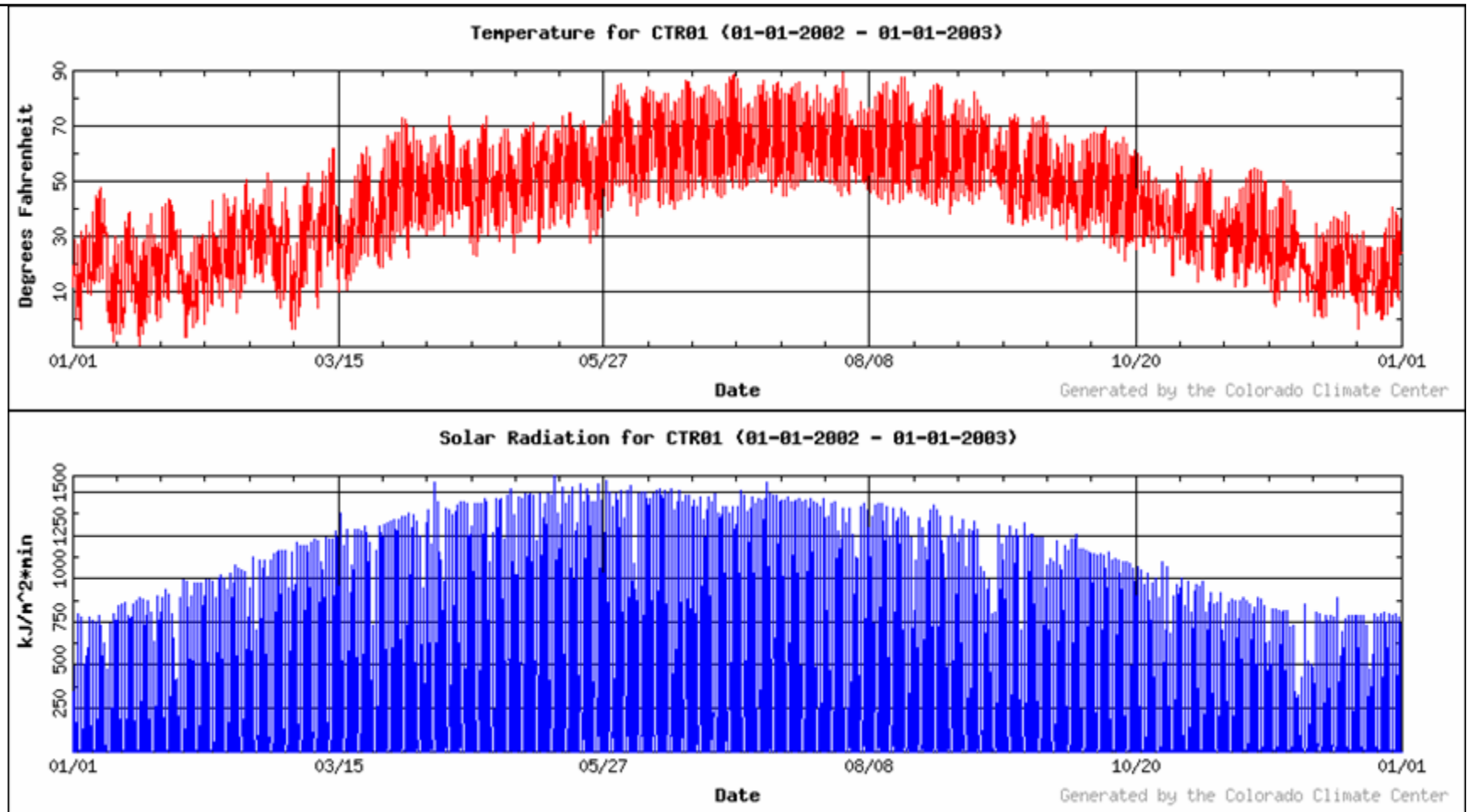
□ *Automated weather stations with daily and hourly readings of:*

- *Temperature*
- *Humidity*
- *Wind*
- *Precipitation*
- *Solar energy*
- *Evapotranspiration*

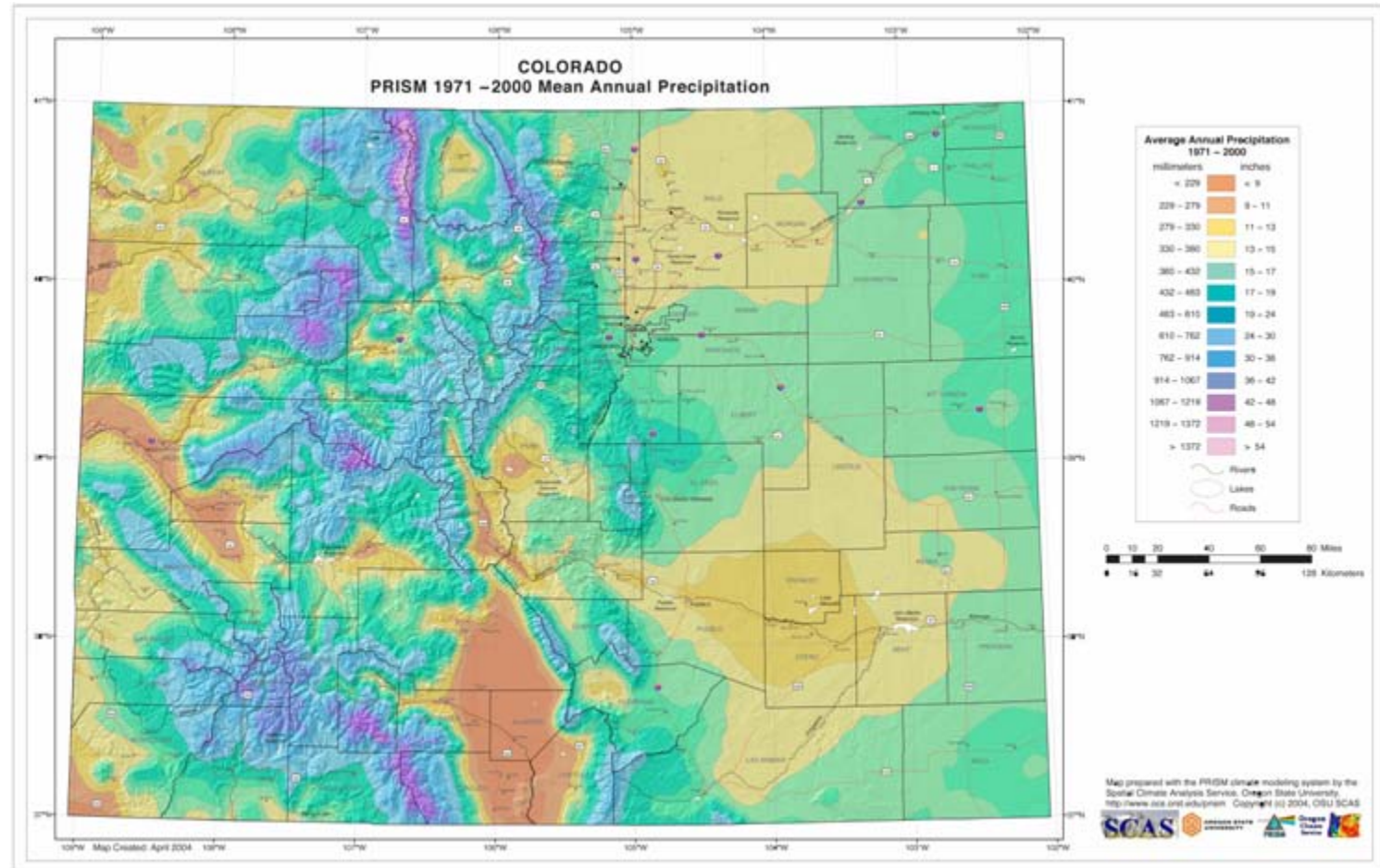


<http://www.coagmet.com>

Center, Colo., CoAgMet Daily Values of Temperature and Solar Radiation



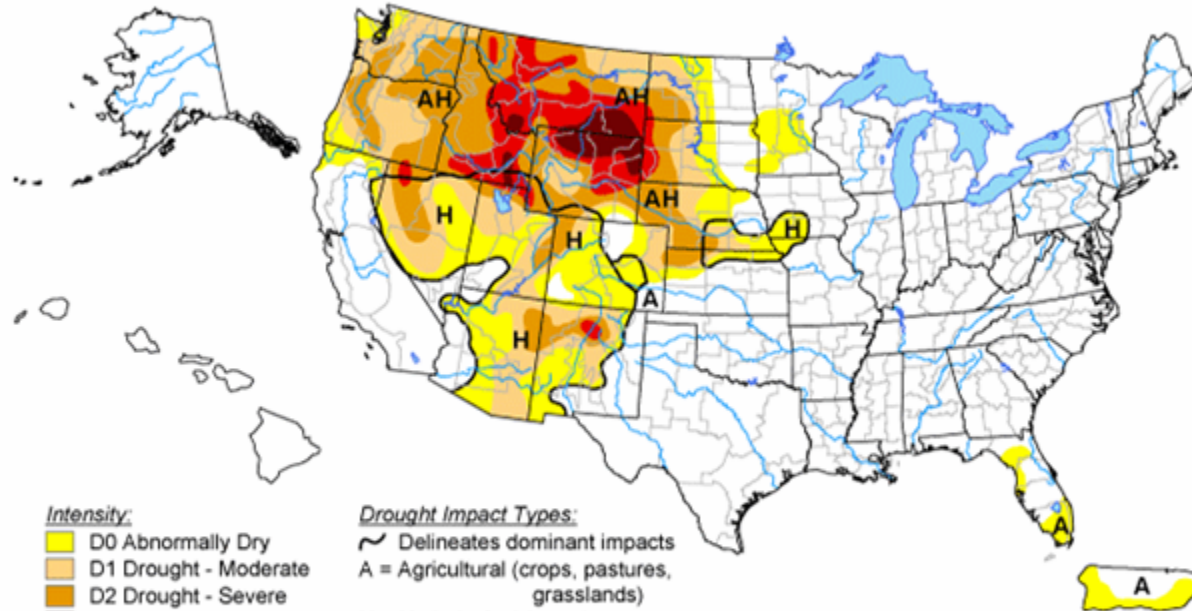
Applications of Climate Monitoring



Applications of Climate Monitoring

U.S. Drought Monitor

March 1, 2005
Valid 7 a.m. EST



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:

- Delineates dominant impacts
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)
- (No type = Both impacts)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

<http://drought.unl.edu/dm>

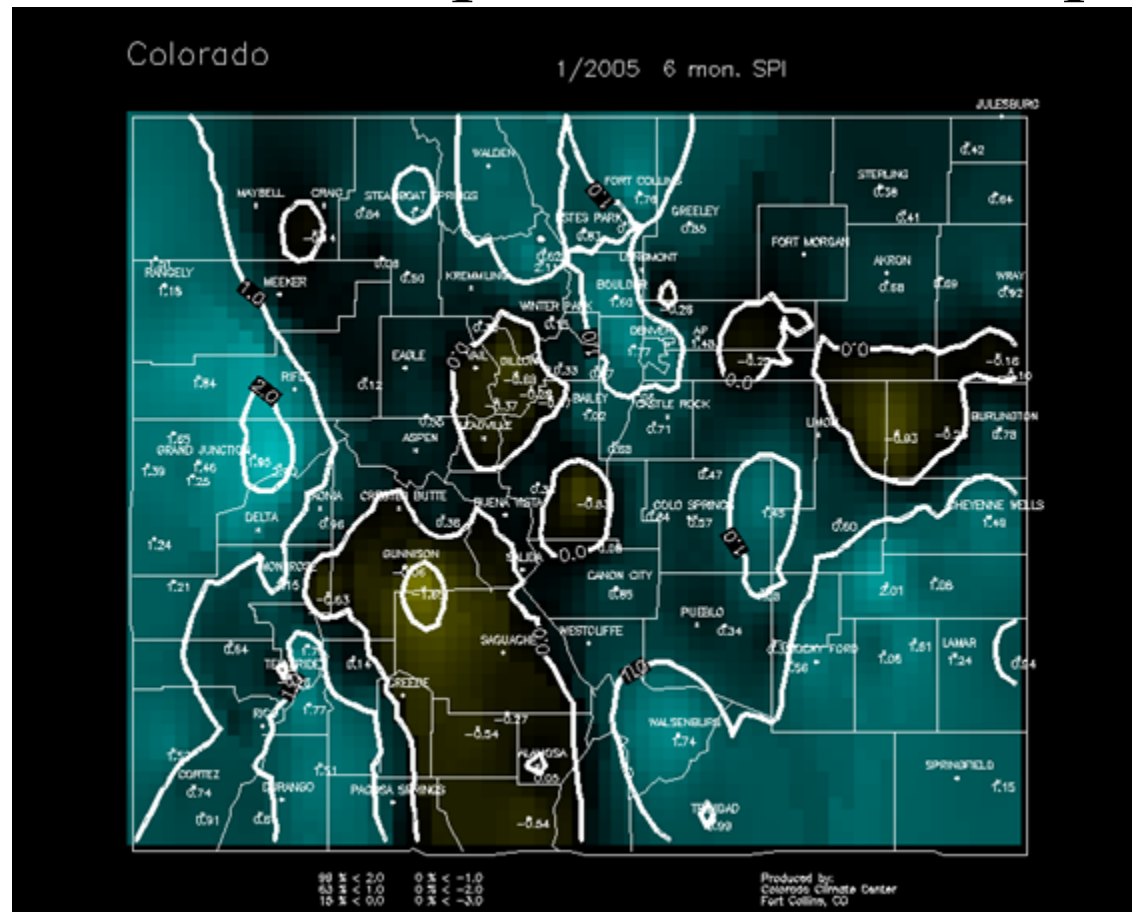


Released Thursday, March 3, 2005

Authors: Richard Heim/Candace Tankersley, NOAA/NESDIS/NCDC

Applications of Climate Monitoring

□ Standardized Precipitation Index Map



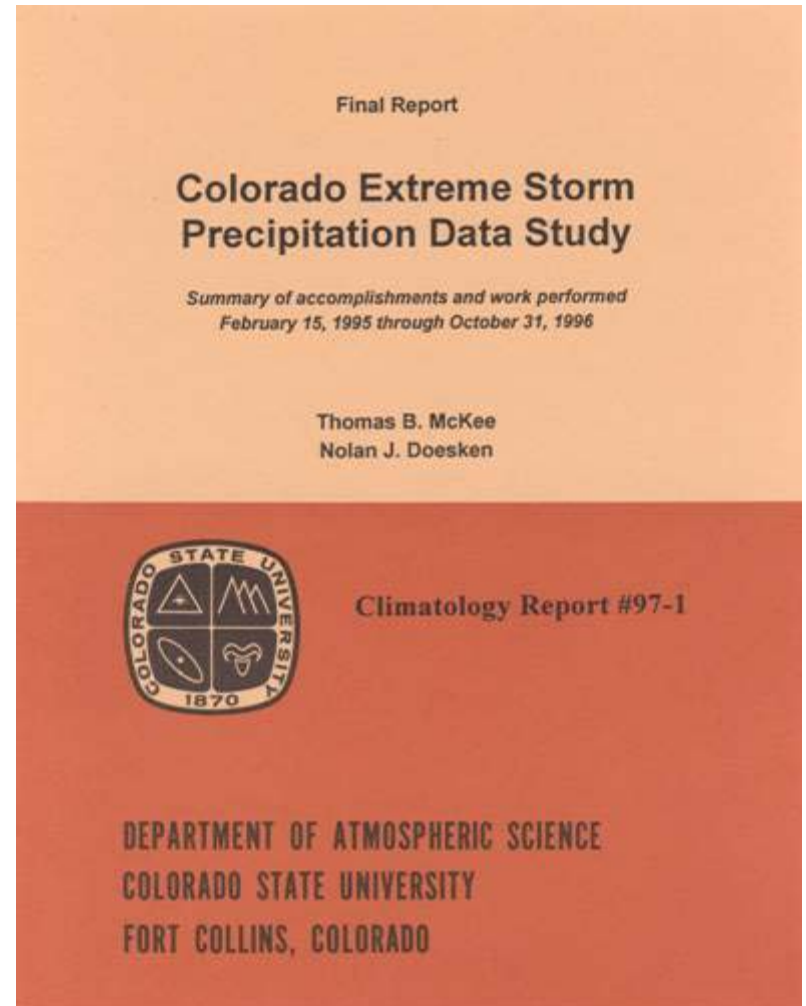
Applications of Climate Monitoring

□ Water Management and Irrigation Scheduling



Applications of Climate Monitoring

□ Extreme Precipitation Study



Applications of Climate Monitoring

□ History of Extreme Rainfall

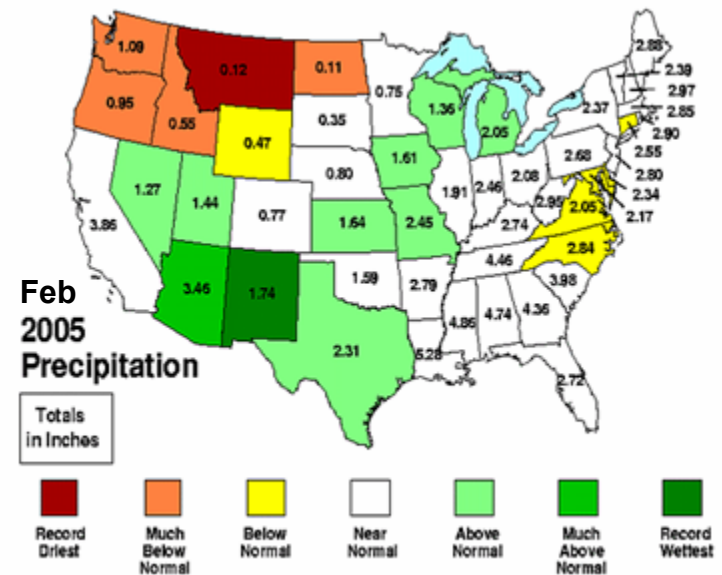
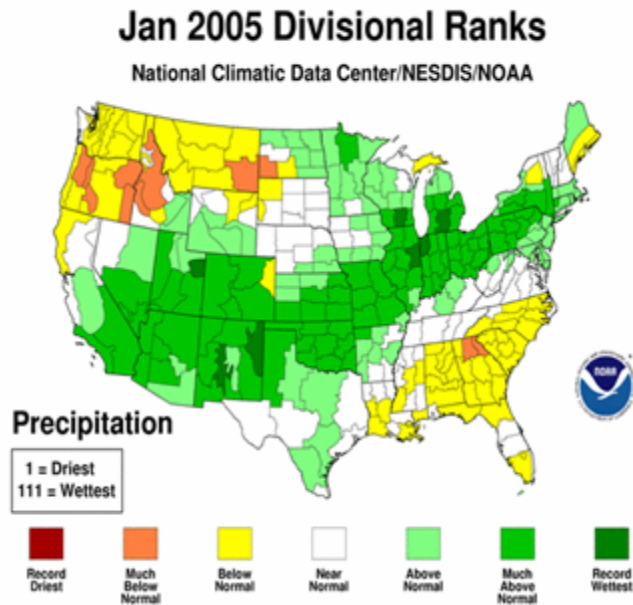
October 1996

Questionable Storm Precipitation Reports

Storm No.	Storm Name	State	Storm Date	Region	Type	Lat	Long	Maximum Precipitation	Remarks	USBR Storm File	USBR Depth Area Dur. Study
40	Gladstone - San Juan Range	CO	October 4-6, 1911	3	G	37 53	107 39	8.05" 24 hrs, Gladstone, CO Definitely a big storm, but Gladstone precip in question	Large flood Durango and Animas River, many 3-4" totals	X	X
48	Telluride	CO	July 27, 1914	3	LC	37 57	107 49	A storm definitely happened but date of reported heavy rain does not match with date of reported mudslide 3.50" 1 day Telluride	Mudslide 7/27/1914 buried Telluride, precip reported on 8/26/14.		
	Leadville	CO	August 18, 1932	3,4	LC	39 15	106 18	2.96" 1 day, Leadville	Nothing noted on forms, precip occurred in 2 storms		
	Leadville	CO	July 23, 1934	3,4	LC	39 15	106 18	5.33" in 3 days - Leadville	2.01" on 21st		
107	Leadville	CO	July 27, 1937	3	LC	39 15	106 18	4.25", 45 minutes, Leadville	Data very suspicious		
114	Masonville	CO	September 10, 1938	2	LC	40 26	105 13	Local reports in SW Fort Collins of 5-7" <1 hr, reports suspect.	No extreme precip. reports found in CO	X	
158	Cimmaron	CO	June 3, 1952	3,5	GLC	38 24	107 31	5.25" 1 day, Cimmaron	Did it really happen?		
	Cimmaron	CO	September 21, 1952	3,5		38 24	107 31	3.60" 1 day	forms not found		
	Cimmaron	CO	January 20, 1962	3,5		38 24	107 31	6.00" 1 day, Cimmaron	CD notes 10" total precip for month		
226	Eagle	CO	September 23, 1969	6		39 38	106 55	1.54" 24 hrs Eagle	No precip at Eagle (FAA), incorrect?		
227	Crested Butte	CO	September 25, 1969	3		38 52	106 58	2.30" 24 hrs, Crested Butte	No precip Crested Butte (NWS) or in state on 25th, incorrect?		
266	Whiskey Creek	CO	August 24, 1982	5	LC	37 13	105 07	3.70" - Whiskey Creek (Snotel site) elevation - 10,220 ft	Measurement suspect, heavy precip in SW CO - some local flooding		
286	Grand Lake	CO	September 28, 1985	4	G	40 16	105 50	3.20" 24 hrs, Grand Lake	Measurement suspect		
295	Scotch Creek	CO	August 19, 1988	3	LC	37 39	108 01	4.10" - Scotch Creek (Snotel site), elevation - 9,100 ft	Measurement suspect		
321	Colorado Springs	CO	September 2, 1994	2	LC	38 49	104 42	5-8" between 9-10:30 pm with lots of hail	Storm occurred but max values of precipitation appear suspect.		
325	Wolf Creek Pass	CO	August 20, 1995	3	LC	37 29	106 47	4.03" in 1 day	Measurement appears suspect		

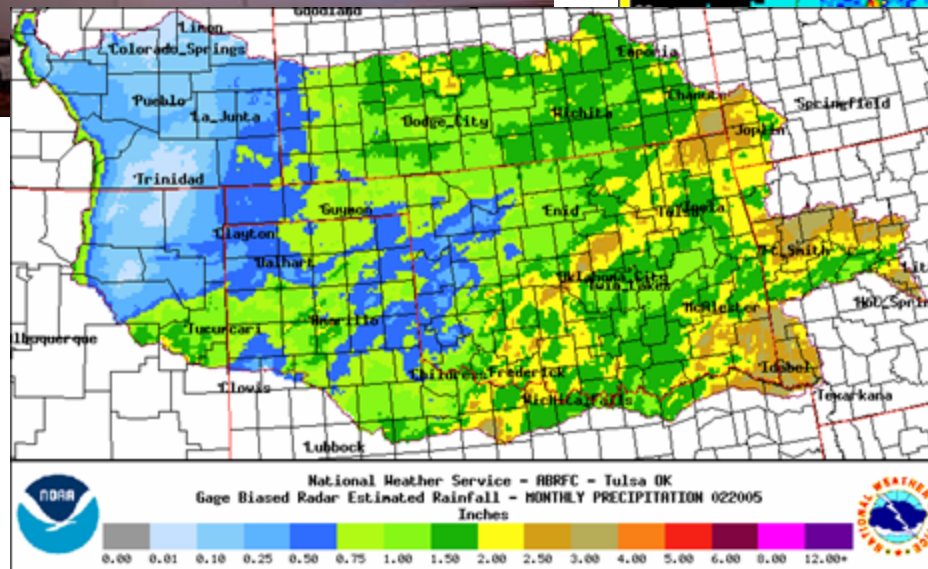
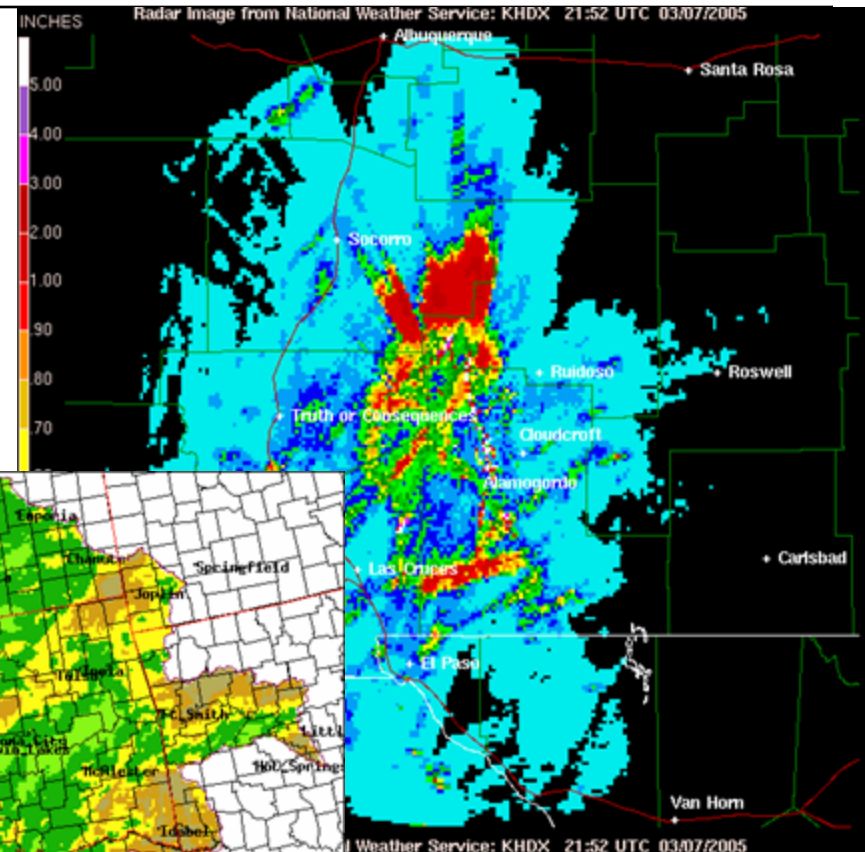
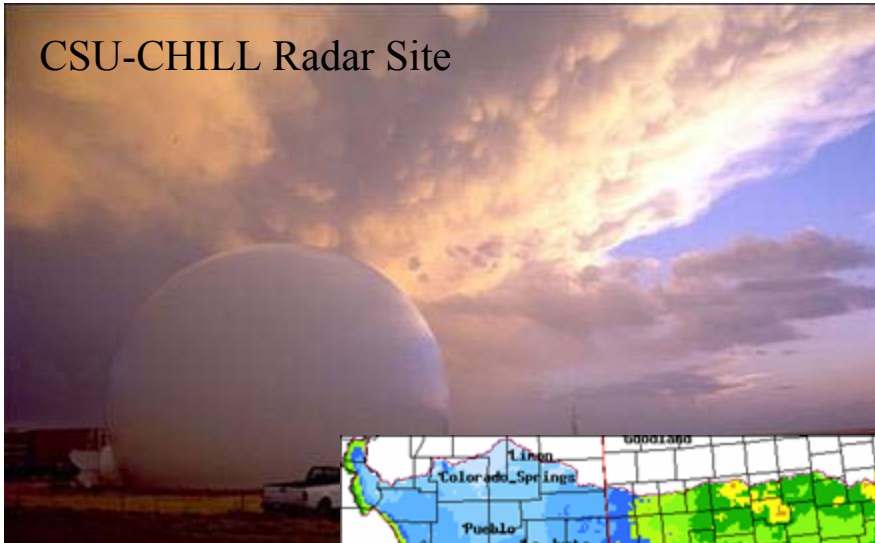
Common Theme from Climate Monitoring Applications is –

Inadequate Spatial Density of Precipitation Data

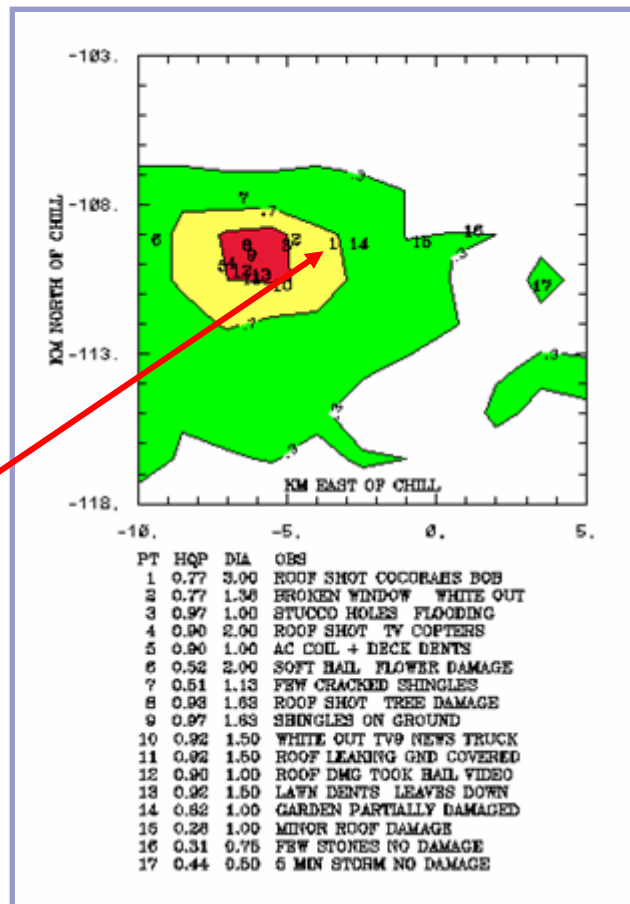
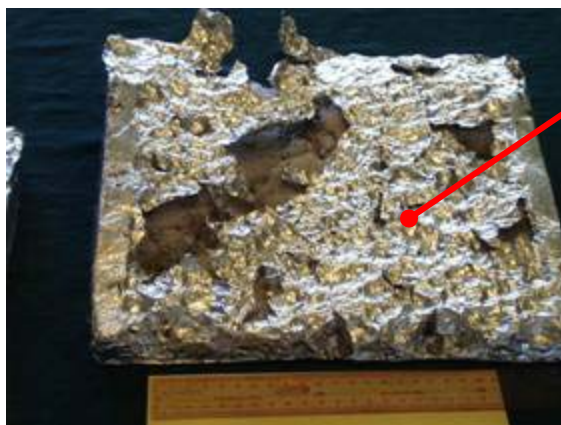


?? How About Remote Sensing ??

CSU-CHILL Radar Site



Remote Sensing is Great – But Ground Calibration is Crucial



Red Arrow indicates location of CoCo RaHS observer. Resulting hailpad and retrieved hailstones. CoCo RaHS observations are also providing valuable spotter information to the National Weather Service.

Contour map of hail quadrature parameter (HQP) showing potential hail damage from a severe thunderstorm in Douglas County, CO, in July 2002. The data were produced from the CSU-CHILL Polametric Radar. CoCo RaHS data are being used as ground validation for the CSU-CHILL hail and rainfall products.

How can we gather more data without breaking the bank??



Community Collaborative Rain, Hail and Snow Network



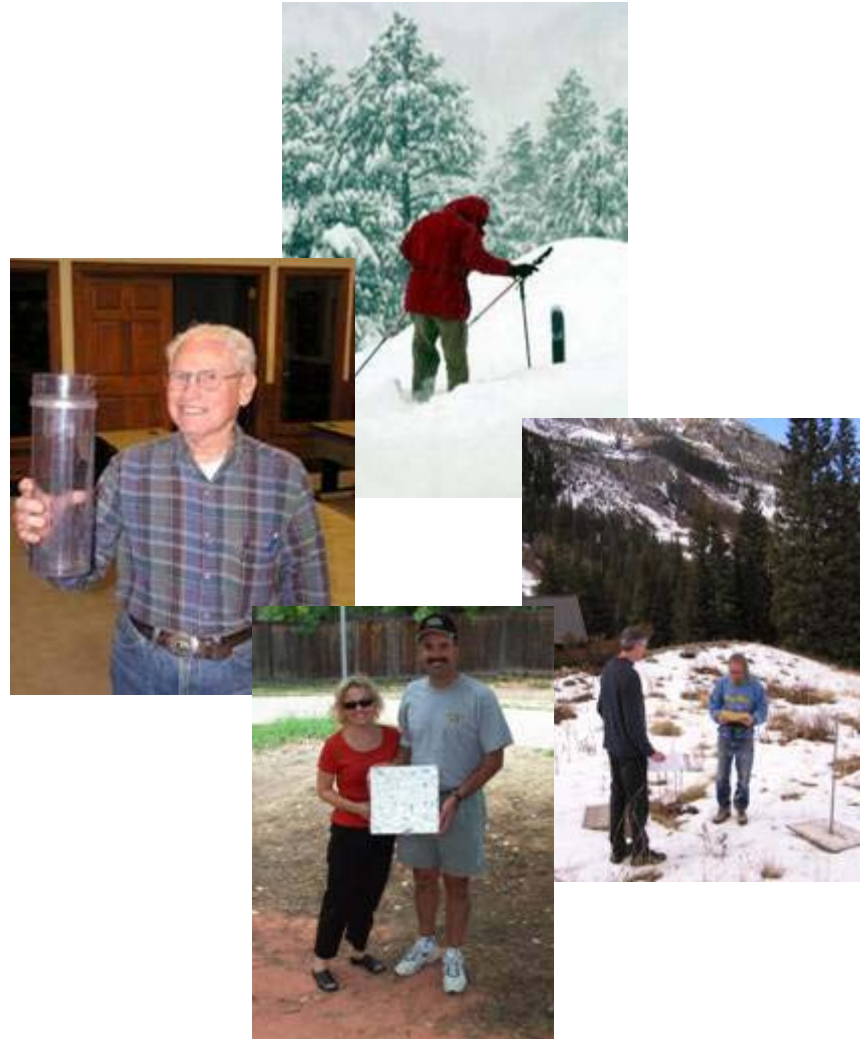
The Origin of CoCoRaHS

The Fort Collins Flood of July 28, 1997



What is CoCoRaHS?

CoCoRaHS is a unique, non-profit community based network of volunteers of all ages and backgrounds working together to measure and map precipitation (rain, hail and snow).



“By using low-cost measurement tools, stressing training and education, and utilizing an interactive website, our aim is to provide the highest quality data for natural resource, education and research applications.”



CoCoRaHS: Simple tools to study rain



Rain Gauge



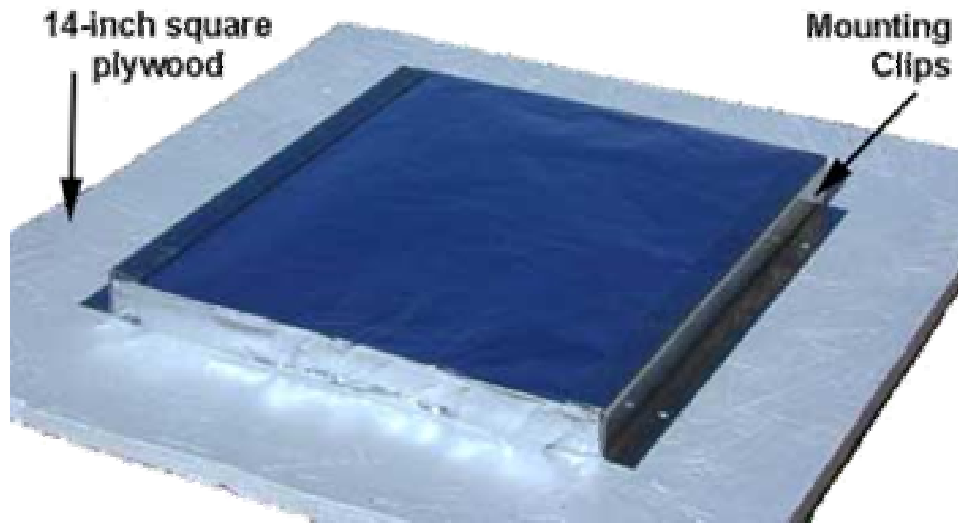
Example Station

CoCo RaHS Gauge in March 2003 Snowstorm



Arapahoe County CoCo RaHS observer near Cherry Creek, Colorado

CoCoRaHS: Simple Tools to Study Hail



Hail Pad



Damaged Hail Pad

Example Hail Pad Stands

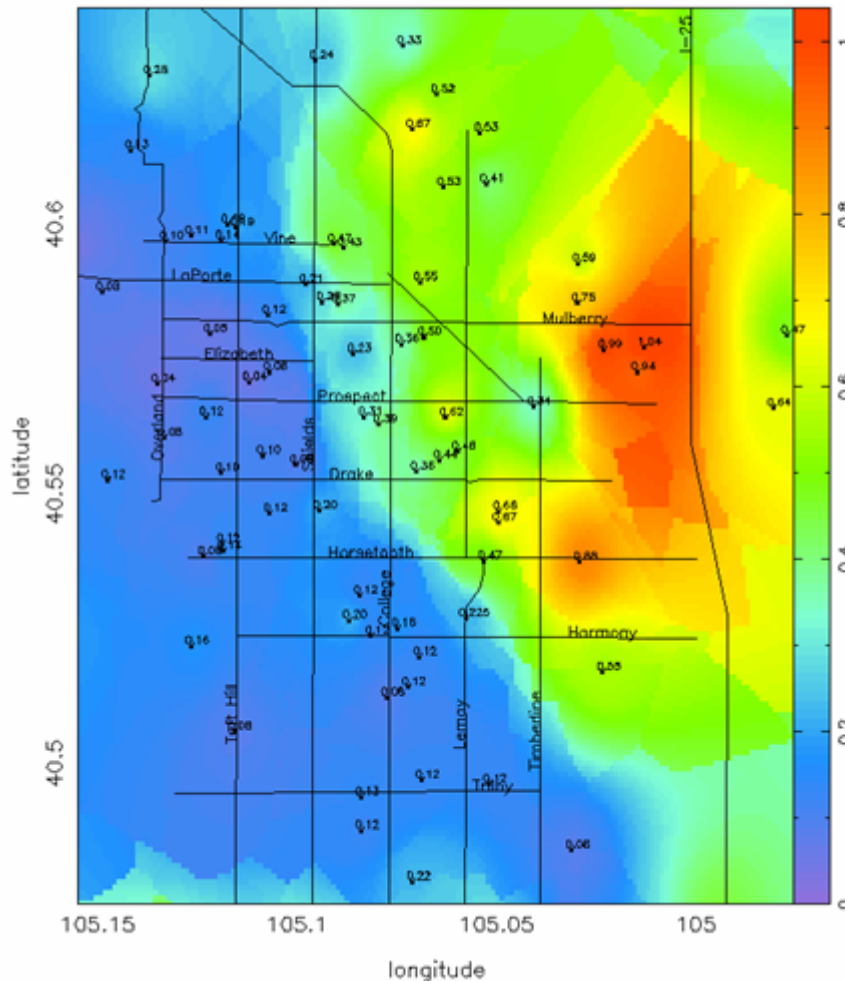


CoCoRaHS -- Supplementing NWS Cooperative Program to Improve Precipitation Measurements.

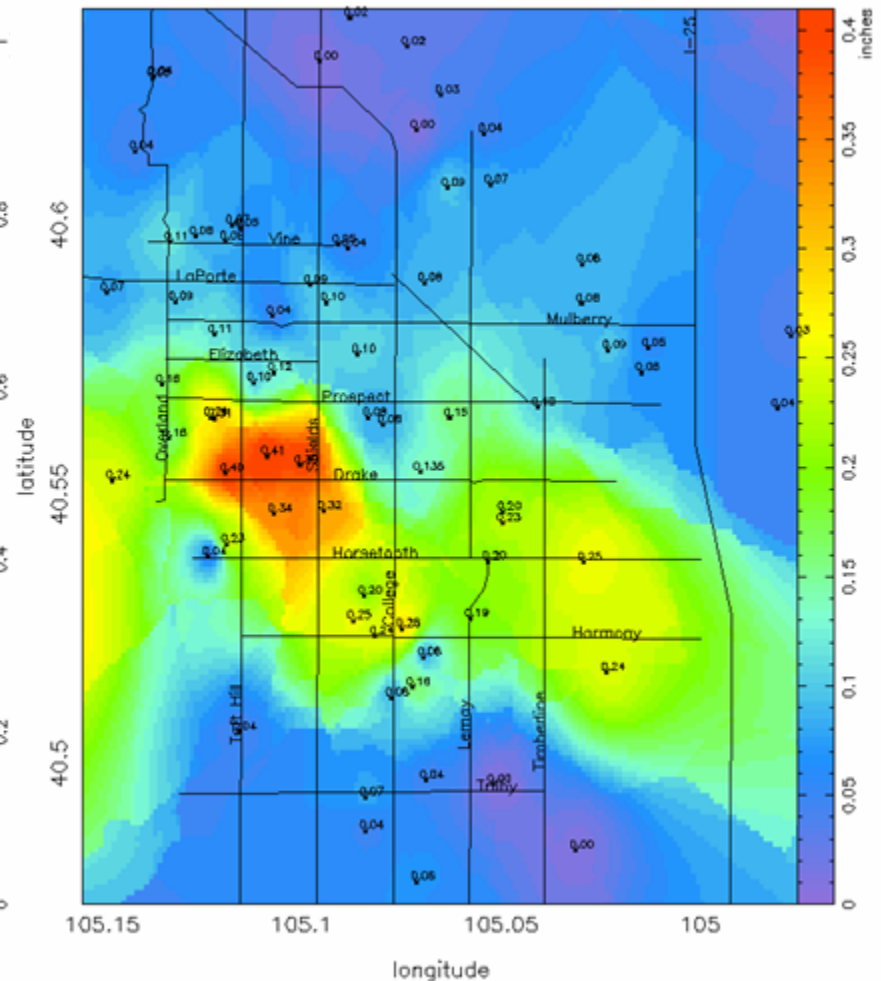


Fort Collins Daily Rainfall Examples

Fort Collins Precipitation Map
For the 24 hour period ending ~7:00 am on 07/13/2001



Fort Collins Precipitation Map
For the 24 hour period ending ~7:00 am on 07/27/2001



Colorado Hailstorm

July 10, 2002, Parker, CO

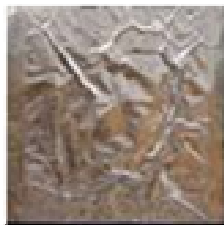


Example Page from CoCoRaHS Web Site of Damaged Hail Pads

July 3, 2002



560



580



736



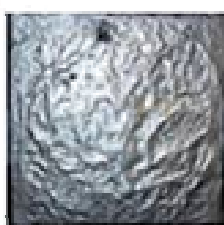
753



JF24



452



JF32

Expanded Hail Information from Web Site



*Date: 7/3/2002
Hail Began: 2:56pm
Hail Lasted: 10
minutes*

*Station Number:
560
Name: Greeley 4.3
NW
County: Weld*

*Common Stones:
Pea
Largest Stones:
Marble
Smallest Stones:
Pea*

*Hailfall was:
Intermittently*

*Hailstones were:
Hard, Mixed*

*Hail started: same
time as rain*

*Average distance
between stones: 1/16
inches*

Depth of hail:

Comments:None

The Quality of Our Data Comes Through the Extensive Training of Our Volunteers



Sample Training Materials

Setting up your equipment

Location! Location! Location!



Photo by Henry Reges

It's the key to good data

Measuring Rain

To measure this amount . . .



Pour out the first inch from the inner tube



Now pour the remaining water into the funnel & measure using the inner tube.

Measuring Snow

Snow measured in
the open



6.5 inches has fallen in the open



As hail is falling . . .

CoCoRaHS HAIL REPORT
www.cocorahs.org

Station Number: _____
Station Name: _____

Name: _____
Home Address: _____
Location of Hail (if different from Home): _____
Date of Storm: _____
Time Hail Began: _____
Time Hail Ended: _____
Your time of hail beginning is correct within: ☐ 1 min. ☐ 2 min. ☐ 3-5 min. ☐ 6-10 min. ☐ 10 or more minutes

Hail Size (largest): _____
Hail Type: _____
Hail Damage: _____
Hail Path: _____

Check All That Apply:

Some Size (inches)	Size (inches)	Shape	Color	Texture	Other
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<input type="checkbox"/> 7 1/4"	<input type="checkbox"/> 7 1/4"	<input type="checkbox"/> 7 1/4"	<input type="checkbox"/> 7 1/4"	<input type="checkbox"/> 7 1/4"	<input type="checkbox"/> 7 1/4"
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<input type="checkbox"/> 8"	<input type="checkbox"/> 8"	<input type="checkbox"/> 8"	<input type="checkbox"/> 8"	<input type="checkbox"/> 8"	<input type="checkbox"/> 8"
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<input type="checkbox"/> 8 3/4"	<input type="checkbox"/> 8 3/4"	<input type="checkbox"/> 8 3/4"	<input type="checkbox"/> 8 3/4"	<input type="checkbox"/> 8 3/4"	<input type="checkbox"/> 8 3/4"
<input type="checkbox"/> 9"	<input type="checkbox"/> 9"	<input type="checkbox"/> 9"			

fill out your CoCoRaHS Hail Report Card. After the storm is over attach it the back of the pad.

Using the Web Site

Enter your report

The screenshot displays the CoCoRaHS (Community Collaborative Rain, Hail & Snow Network) web interface. The header includes the CoCoRaHS logo and the tagline "Because every drop counts". Navigation links include Home, States, View Data, Maps, My Data, My Account, Admin, and Logout. The left sidebar contains a "Main Menu" with links to Home, Join CoCoRaHS, Contact Us, and In the Spotlight. The main content area is titled "Precipitation Report Form" and includes a "Submit Data" button and a "Reset" button. The form fields are as follows:

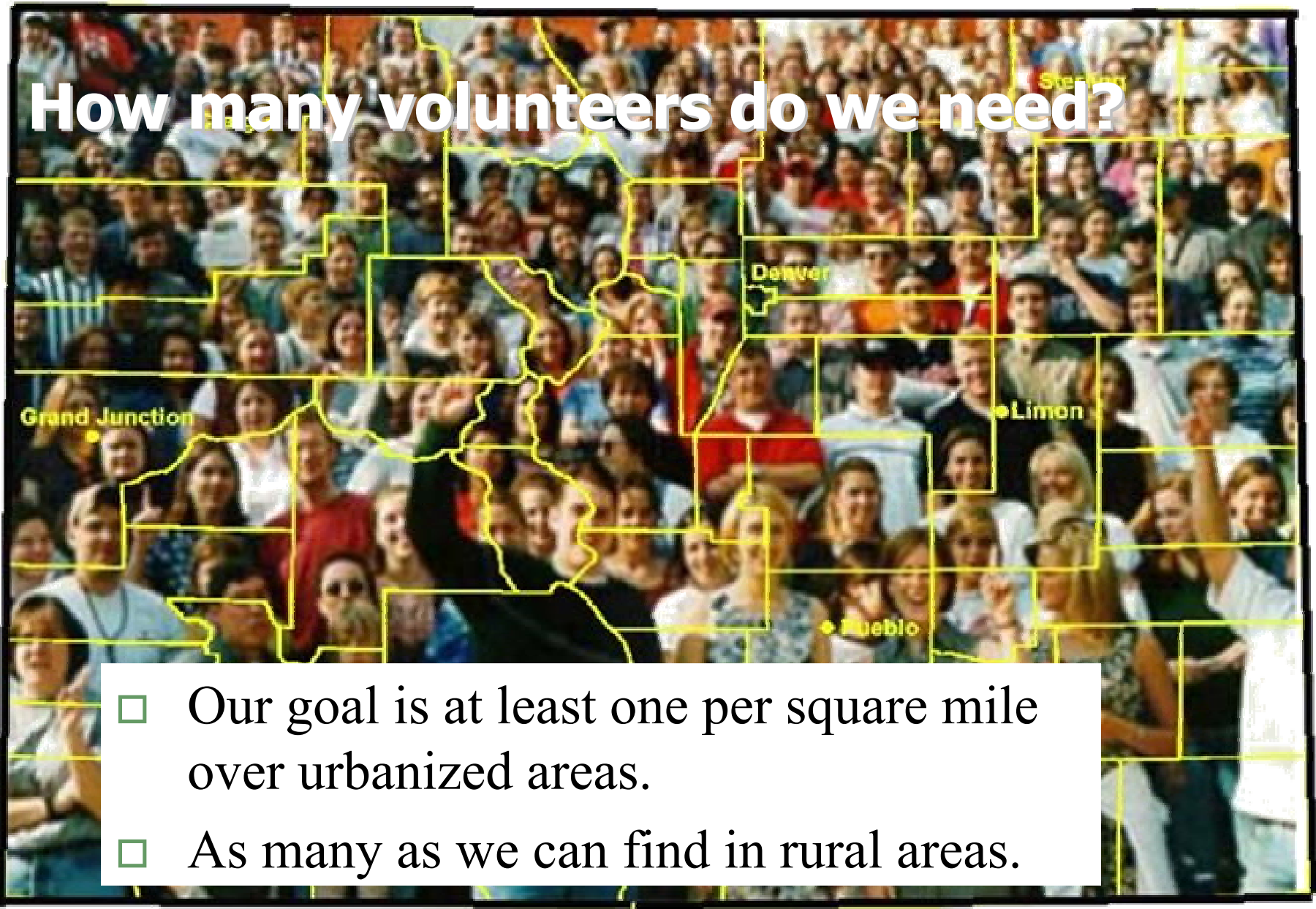
Precipitation Report Form	
Station Number : CO-LR-273	
Station Name : FCL 2.2 NW	
2/23/2005	Observation Date
7:00 AM	Observation Time
0.00	Total Precipitation (in inches)
<input checked="" type="radio"/> Yes <input type="radio"/> No Report was taken at registered location?	
Notes	
Snow Information	
0.0	New Snow Amount (in inches)
0.0	Total Depth of Snow on Ground (in inches)
0.00	Core Precipitation (in inches)
0.00	Snow Water Equivalent (SWE)

Red arrows point from the text annotations to the "Select Report Type" dropdown menu, the "Total Precipitation" field, and the "Notes" text area.

Record your measurement in hundredths (0.00)

Here you will enter the total precipitation measured in your gauge

How many volunteers do we need?



- ❑ Our goal is at least one per square mile over urbanized areas.
- ❑ As many as we can find in rural areas.

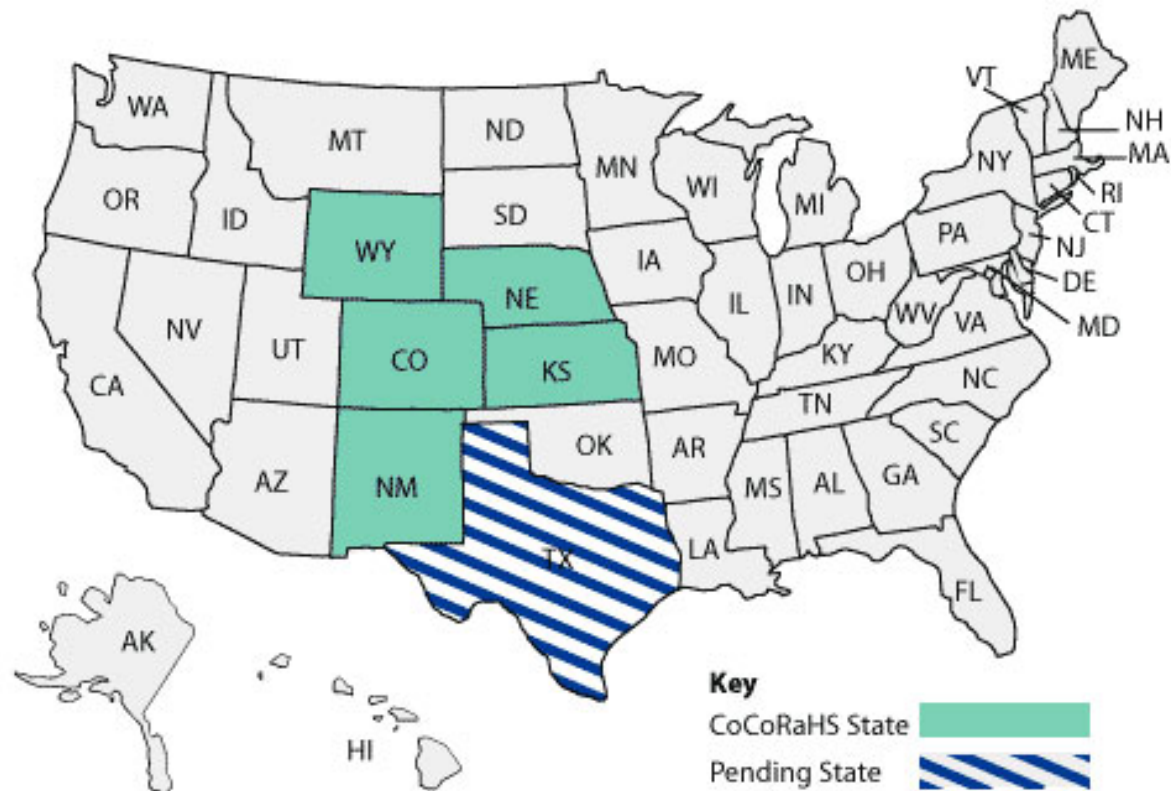


CoCo RaHS is Growing!!

- More states,
- More staff,
- More collaboration,
- More science,
- More education,
and
- Many more participants.

Participating CoCoRaHS States

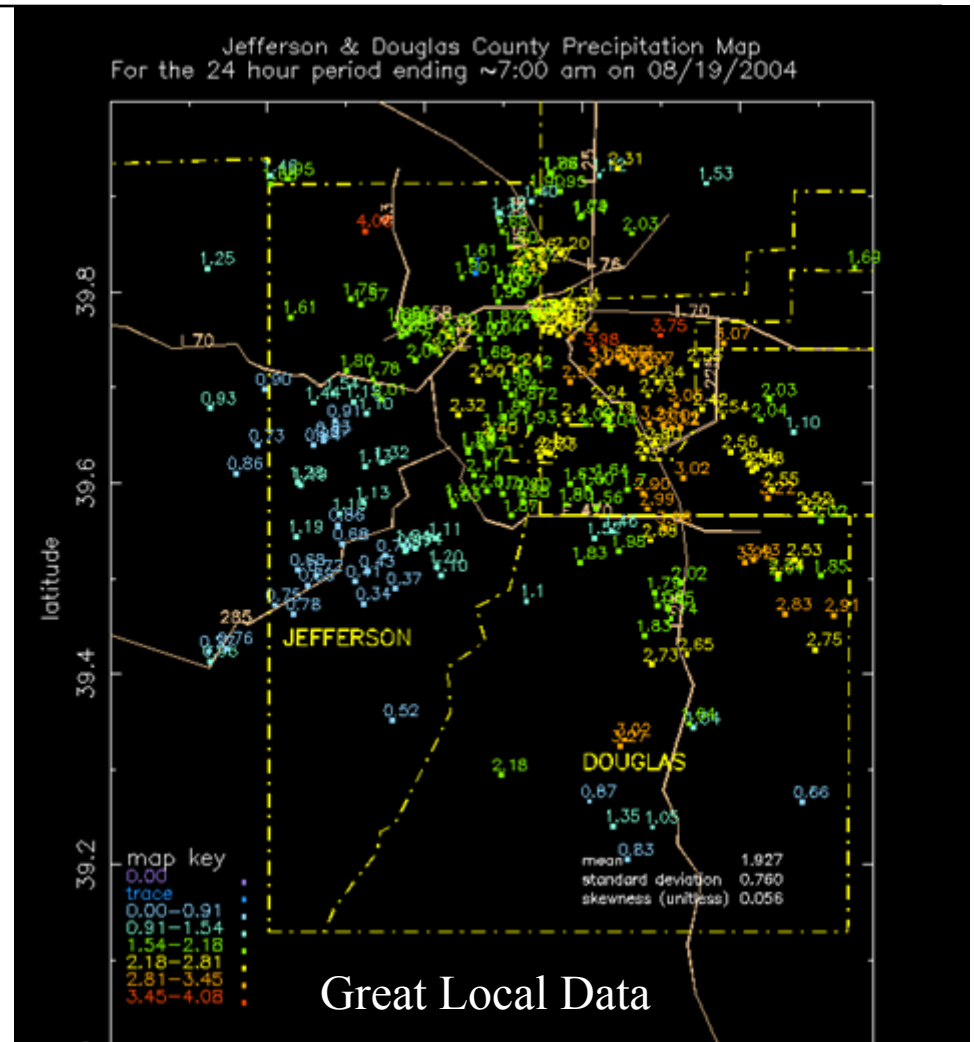
Welcome to CoCoRaHS



The Benefits of CoCoRaHS



Learning Together



For More Information, Visit the CoCoRaHS Web Site



<http://www.cocorahs.org>



Support for this project provided by
Informal Science Education Program,
National Science Foundation
and
many local charter sponsors.

Colorado Climate Center

Data and Power Point Presentations available for downloading

<http://ccc.atmos.colostate.edu>

- click on “Drought”
- then click on “Presentations”

